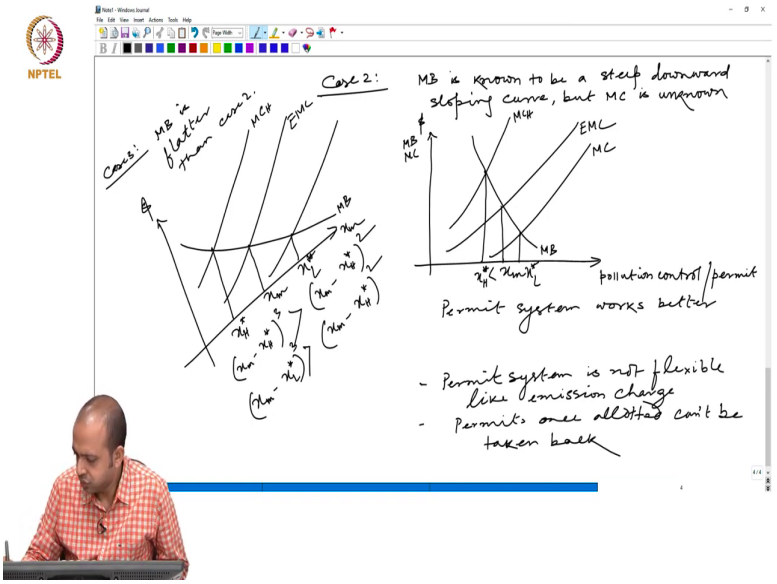
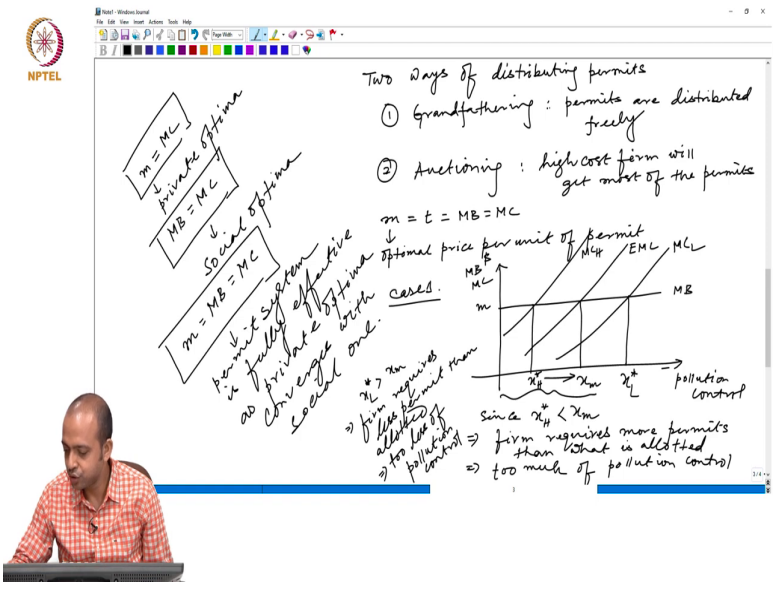
Environmental & Resource Economics
Professor Sabuj Kumar Mandal
Department of Humanities and Social Sciences
Indian Institute of Technology, Madras
Lecture 28
Incentive Design Under Uncertainty and Effectiveness Part – 4

(Refer Slide Time: 0:14)





Then, let us say case 2. Here, MB is known to be a steep downward sloping curve but MC is unknown. So, let us say that, this is again pollution control or permit both you can measure and this is dollar MB and MC, this is let us say your MB, this is expected this thing. So, this

is xm amount of permit given, decided. Now, if your xm, x this is let us say marginal cost higher. So, this is xH star and let us say.

So, in this case what is happening? In this case again xH star is lower than this, so that means firms are forced to go up to xm level of pollution control. So, that means, there is divergence between social Optima and private Optima, but if you compare this situation with the earlier one, the amount of divergence is coming down. So, the amount of divergence is coming down in this case.

Similarly, if MC low, so this is the amount of x L star, again there is a divergence between private Optima and social Optima, but the amount of divergence is going down. So, that means tradable permit system works better when the marginal benefit is steep straight line, if you make it even more steeper, even more steeper than the divergence, the difference between x m and x H and x m and x L will go down.

So, that means in this case permit system works better. If you make it more flat then in case 3, what will happen. Let us say that this is case 3, MB is flatter than case 2. What will happen? So, this is your instead of steep straight line, let us say that MB is like this, so this is your EMC, so this is your MCH. So, that means this is x m, this is x H star, let us say this is x L star.

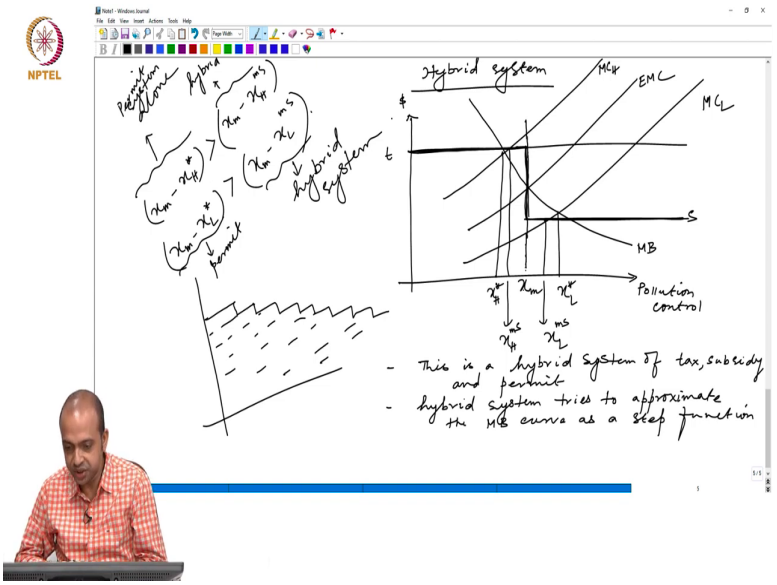
So, again what is happening here, the divergence between the difference between x m and x H, in this case x m minus x H star, in case 3 is higher than I will say that x m minus x H star in case 2. Similarly, the difference between x m and x L star is higher in 3 compared to x m minus x H in 2, case 3.

So, that means, the permit system works poorly when your marginal benefit curve becomes flatter and if you rotate this MB again clockwise then you will get a situation where MB will again become a flat straight line and then permit system will be fully ineffective. So, that means that effectiveness of permit system and emission charge is just the opposite, when the policymaker is uncertain about the marginal cost of control, but certain about the marginal benefit in that case, these two instruments works in a different direction, while emission charge is fully effective in the case 1, it is completely ineffective in case 1 in case of permit.

And then as the MB curve becomes flatter or steeper, the effectiveness of permit system and emission system is just quite different. So, you need to compare these cases to understand the

mechanism. Now, in sort in nutshell why the permit system is not working fully in this particular system, because permit system is not flexible like emission charge. Permit once allotted cannot be taken back, that is why the problem arises.

(Refer Slide Time: 08:24)



Now, there is one more instrument based on this experience of permit system and emission system. Some economists they suggested a hybrid system, what is that hybrid system? So, that means, you have a system wherein multiple instruments are working simultaneously. So, you have emission tax, you have permit, and you have some amount of subsidy also. And if that is the case, that is called hybrid system.

So, what happens in that case, let us try to understand a hybrid system, effectiveness of your hybrid system. So, here it is pollution control and here it is dollar. Let us say that this is your EMC, expected marginal cost, and this is your x m is the permit. If your actual cost of abatement is higher than these expected one then what happens let us say that this is MCH and let us say that this is your MB.

So, intersection between MB and EMC decided about the optimal level of permit. So, if it is higher than this, so obviously, there would be a divergence because x m is higher than this. Now, how will you solve this divergence? The divergence to solve this divergence what happens you impose a tax, let us say that this is the tax rate or let us say instead of this let us say that the tax rate is this. So, this is let us say x H in mix system.

So, that means, when your marginal cost is higher than the expected you have one tax rate, is that fine? So, what is happening here even though you have a divergence, the divergence is going down, why because the difference between x H star minus x m is higher than x H star minus x H in m S, m S means mixed system.

So, by imposing a tax also, if I allow a tax also then what is happening that system works better than a system where only the permit system is working. Similarly, let us now assume that your MC is lower than what you expected. So, this is again the optimality which is let us say x L star. So, there is a difference between x L and x m, to solve this divergence, what the policymakers are doing, they are giving a subsidy here, let us say that this is subsidy S.

And when the subsidy is given, then what will happen they will equate the subsidy amount sorry, subsidy is given let us say this is a subsidy is given here, this is subsidy. So, this is the amount let us say x L in a m S. So, here also x L star minus x m is greater than x L star minus x L, instead of writing in this way, I will write in this that way.

Let us say that x m, the first condition x m minus x H star is greater than x m minus x H m S. In this case also, the divergence minus x L star is again higher than x m minus x L star sorry, in this is m S. So, that means in this hybrid system what are the instruments working, tax, subsidy, and permit.

Now, what we are trying to do here. So, this is a hybrid system of tax then subsidy and permit, when actual abatement cost is higher than expected, we are giving, we are imposing tax also to reduce the divergence. When the actual tax rate is lower than expected, then we are giving subsidy, why this is so, because if permit system, if we allow permit system to work alone, then there will be too lesser pollution control, we have already seen earlier that when this is low permit system is not flexible, we will have too lesser pollution control.

Now, how to motivate the form to go for more pollution control in this case, you give subsidy, additional pollution control means you will get some amount of subsidy. When the actual cost is higher than what you have expected we have seen earlier if the permit system works alone, then we will have too much pollution control, too much a pollution control we are expecting that means in that case you impose some amount of tax.

So, this tax will help, will motivate the firm to go up to this much. So, the divergence will come down. So, that means with this hybrid system then, what is happening here if you look

at our marginal benefit curve is not these in the curve rather the effective marginal benefit curve is a step function like this, this is like this and then this, please try to understand.

So, instead of having a downward sloping MB rather our effective MB is a step function. So, hybrid system tries to approximate the MB curve as a step function, that is why the divergence is going down. If you, in reality, if we make more steps in this step function, the effectiveness of hybrid system improves, but if the number of steps is more then it would be very challenging for the policymaker also to assign that many tax, subsidy, and x m, because too many steps mean, too many tax and subsidies here I have only one, but then in ideal case, what will happen your benefit card would be like this, so too many tax system.

And in extreme case, again it will become like a downward sloping, that means you have too many tiny steps in this MB function. So, that is how a hybrid system works better than the permit system alone, because what is happening, we are trying to utilize the benefit of permit system and the benefit of tax system in this hybrid one.

When the MC is higher than the expected one, then what is happening there is too much operation control we are expecting in a permit system alone, then tax system dumping that type of, it gives a dampening effect and increase the optimal level of pollution control and that is why the divergence goes down.

Similarly, when it is low, then too less population control we are asking for and the moment I impose this subsidy, then that gives some kind of additional incentive to the firms for going for, to go for extra amount of pollution control and that is why you can see from here that x m minus x H star the divergence is higher when this is permit system alone. This is the divergence in effectiveness and this is a hybrid system.

So, in both the cases, whether your actual marginal cost is higher or lower, we can see that the divergence, amount of divergence in case of the hybrid system is lower than permit system working alone. That is why we say that a hybrid system is better than the permit system or tax system working alone, because here we are trying to take the advantages of both the system and combining into a hybrid one. So, with this, we are closing our discussion today and we will meet again in our next class to discuss the remaining portion of this incentive designing. Thank you.